Accepted Manuscript. The Version of Record of this manuscript has been published and is available in Hydrological Sciences Journal (2026) https://www.tandfonline.com/doi/10.1080/02626667.2025.2593331

Breaking vicious cycles of hydrological disasters and socioeconomic inequalities

Giuliano Di Baldassarre[1,2,3], Mariana Madruga de Brito[3], Sara Lindersson[1,2], Frederike Albrecht[4], and Maria Rusca[5]

[1] Department of Earth Sciences, Uppsala University, Uppsala, Sweden

[2] Centre of Natural Hazards and Disaster Science, CNDS, Uppsala, Sweden

[3] Uppsala University Conflicting Objectives Research Nexus, UUniCORN, Uppsala, Sweden

[4] Helmholtz Centre for Environmental Research (UFZ), Leipzig, Germany

[5] Swedish Defence University, Stockholm, Sweden

[6] Global Development Institute, University of Manchester, Manchester, United Kingdom

Correspondence: giuliano.dibaldassarre@geo.uu.se

Abstract. Floods and droughts often worsen socioeconomic inequalities, as marginalized groups face disproportionate impacts and have fewer resources to recover. Inequalities, in turn, limit their ability to recover, and amplify the impacts of future hydrological extremes, creating vicious cycles of worsening disasters. Yet, such floods and drought events can also serve as opportunities for transformative change addressing underlying vulnerabilities and reducing inequalities. Progress in sociohydrology is essential for better understanding these two-way interactions, requiring case studies and models of human-water systems that account for uneven risk distribution, along with global comparative analyses using emerging datasets. We propose an interdisciplinary research agenda that combines sociohydrological modelling, critical social science perspectives on power and inequality, and the innovative, but carefully scrutinized, use of AI tools, such as text mining. This integrated approach can reveal context-specific dynamics, and help break vicious cycles of disasters and inequalities.

Keywords: Floods, droughts, climate impacts, disasters, poverty, inequity, sociohydrology

Floods, droughts and inequalities

Hydrological extremes, i.e. floods and droughts, can exacerbate socioeconomic inequalities, as their impacts are unevenly distributed. Marginalized communities are often hit the hardest and face greater relative losses (Cappelli et al., 2021; Carter et al., 2007; De Silva and Kawasaki, 2020; Finch et al., 2010a; Hallegatte et al., 2020; Tovar Reaños, 2021a), even if the absolute monetary losses may be higher for wealthier groups with more assets to loose. Moreover, they tend to have fewer resources to respond and recover (Finch et al., 2010b; Kammerbauer and Wamsler, 2017; Thaler and Hartmann, 2016a).

These unequal impacts are rooted in structural patterns of vulnerability shaped by intersecting inequalities, such as socioeconomic status, gender, race and ethnicity disability, or age, and power asymmetries (Andrijevic et al., 2020; Bates, 2023; Bolin and Kurtz, 2018; Choong et al., 2025; Cutter et al., 2003; Elliott and Pais, 2006; Nature, 2023; Kruczkiewicz et al., 2023; Lindersson et al., 2023; Rusca et al., 2023; Sanders et al., 2023; Savelli et al., 2023; Wing et al., 2022). For instance, the development of risk reduction measures, such as dams and reservoirs alleviating floods and droughts, often mirrors these inequalities. Their design and distribution are usually steered by economic and political interests that exclude those most vulnerable (Rusca et al., 2023). Thus, power asymmetries drive spatial and socio-economic marginalization, which can worsen disaster risk by concentrating resources and infrastructures in high-income neighbourhoods (Collins, 2009; van Bavel et al., 2018).

The 'Day Zero' water crisis in Cape Town, South Africa, epitomises how the occurrence of hydrological extremes can worsen socio-economic inequalities. Between 2015 and 2018, the region faced a prolonged drought that drastically reduced water availability. Reservoir levels supplying the city dropped to below 25% of capacity (Botai et al., 2017). In response, authorities imposed strict drought restrictions and raised water tariffs. By January 2018, Cape Town residents were limited to a maximum of 50 litres per person per day (Cooke, 2019). Marginalised groups living in townships and informal settlements were hardest hit by the restrictions, while affluent and middle-income households could offset the crisis by turning to alternative supplies, including bottled water, rainwater harvesting tanks, and private boreholes built in response to the drought. At the same time, the drought exacerbated existing inequalities.

Figure 1a shows that the city elite recovered shortly after the water crisis and improved their level of water security by investing in alternative water sources, such as private boreholes (Savelli et al., 2021). In contrast, the middle class and the urban poor faced prolonged drought restrictions and a lasting reduction in water security compared to pre-drought conditions (Savelli et al., 2021).

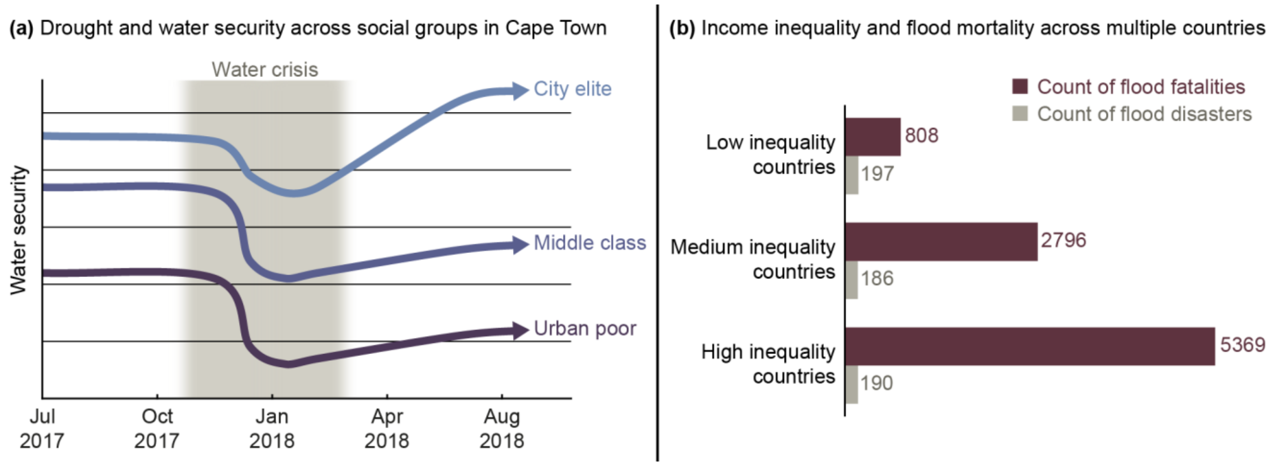

Figure 1. Disasters can exacerbate inequalities, and vice versa. (a) Increased inequalities in Cape Town after the 2015-2018 drought (after Savelli et al., 2021). **(b)** More unequal countries face substantially more flood fatalities (after Lindersson et al., 2023). Inequality is quantified by the Gini index of disposable income at the country level (Solt, 2025) in the year of each event; the sample was divided into three equal groups, with "low inequality" defined as a Gini index below 34 and "high inequality" as above 42.5.

Socioeconomic inequalities, in turn, can exacerbate the impacts of hydrological extremes. Large inequalities often reflect widespread poverty and limited resources to prevent, cope with, and recover from disasters (Rusca et al., 2021). Taken together, these factors define the everyday realities faced by marginalized populations and shape the outcomes of extreme events.

The deadly flooding in New Orleans, United States, following Hurricane Katrina (2005) illustrates how inequalities can worsen disasters (Fussell et al., 2010; Jonkman et al., 2009; Kates et al., 2006; Masozera et al., 2007). Low-income and marginalized groups were more exposed and vulnerable to the destructive impacts of Hurricane Katrina, also due to decades of public disinvestment that had left New Orleans increasingly racially segregated and economically uneven (Bullard & Wright, 2009). Many could not evacuate in time due to limited access to private transport, such as cars, and lack of public services (Masozera et al., 2007). Moreover, many low-income neighbourhoods consisted of mobile or stick-built houses, highly susceptible to flooding (Finch et al., 2010b). These areas were also disproportionately exposed to levee failures (Jonkman et al., 2009) and severe contamination after flooding because of their proximity to toxic and industrial sites (Picou, 2009). The outcome was catastrophic, with over 1,100 fatalities (Jonkman et al., 2009) and highly uneven recovery trajectories (Fussell, 2015). For instance, African Americans did not only experience greater relative economic losses, but were also four times more likely than white workers to lose their jobs in the aftermath of the flooding (Elliott and Pais, 2006).

Cross-national evidence shows that these dynamics also hold at a global scale. More unequal societies tend to invest less in disaster risk reduction (Anbarci et al., 2005) and, as a result, are often more severely affected by disasters (Oronce et al., 2020). Lindersson et al. (2023), for example, examined the relationship between flood mortality and economic inequality, measured by the Gini index of disposable income (Solt, 2020), and found that floods claim significantly more lives in unequal countries (Figure 1b). The analysis was conducted using more than 500 geocoded records of major flood disasters in 67 middle- and high-income countries between 1990 and 2018. Importantly, this association remained robust even after accounting for potential confounders such as per capita GDP and population numbers of the impacted regions.

These two-way feedbacks between hydrological extremes and socioeconomic inequalities (Figure 1) can spiral into vicious cycles of escalating disparities and catastrophic impacts. Scholars across different fields have explored the links between disasters and inequalities (Adger, 2006; Cutter et al., 2003; Enarson, 1998; Lindersson et al., 2023; Parthasarathy, 2018; Rusca et al., 2023; Savelli et al., 2023; Thaler and Hartmann, 2016b; Tovar Reaños, 2021b; van Bavel et al., 2018; Vin and Kawasaki, 2024). Recent reviews by Rusca et al. (2021, 2023) show a consistent pattern: privileged groups often recover quickly, or even improve their circumstances, after the occurrence of extreme events, while marginalized groups tend to recover slowly, or not at all.

Addressing these disparities requires a new generation of sociohydrological models of human-water systems is needed that captures the distributional dimension of hydrological risk and explicitly considers how vicious cycles of disasters and inequalities might be disrupted. Advancing such models, hinges on embracing a range of theories and methods for the study of the interplay between social and natural processes developed across multiple fields, such as disaster studies, ecological economics, political ecology, social-ecological systems, and sociohydrology (Braun, 2015; Ferraro et al., 2019; Folke et al., 2005; Kallis, 2010; Liu et al., 2007; Pahl-Wostl et al., 2010; Rusca, 2024; Schlüter et al., 2019; Siddiqi and Collins, 2017; Sivapalan et al., 2012; Turner et al., 2003). In what follows, we discuss how disasters and inequalities reinforce one another, explore the potential for disrupting these vicious cycles, and propose an interdisciplinary research agenda.

Accepted Manuscript. The Version of Record of this manuscript has been published and is available in Hydrological Sciences Journal (2026) https://www.tandfonline.com/doi/10.1080/02626667.2025.2593331

Vicious cycles and windows of opportunity for disrupting them

The two-way feedbacks between hydrological extremes and socioeconomic inequalities can spiral into vicious cycles of escalating disparities and catastrophic impacts. These cycles can be further accelerated by global change: socioeconomic trends indicate that the gap between poor and rich for around 68% of the global population (Chrisendo et al., 2024; United Nations, 2020), while climate change is expected to increase the frequency and intensity of hydrological extremes across many regions worldwide (Intergovernmental Panel on Climate Change, IPCC, 2023).

Concurrently, the occurrence of major floods or droughts can potentially be a window of opportunity for transformative change (Birkmann et al., 2010; Adger et al., 2005; Olson and Gawronski, 2003), which may reduce inequalities. Efforts in disaster risk reduction, for example, can lower vulnerability and promote equity. At the same time, measures for poverty alleviation can in turn reduce disaster risk (Hallegatte et al., 2020). These synergetic effects have the potential to disrupt vicious cycles of inequalities and disasters. Yet, there remains limited empirical evidence of these disruptions. Building on this idea, Figure 3a shows a simplified system dynamics model (Mazzoleni et al., 2021; Mirchi et al., 2012) to illustrate how disasters and inequalities can interact through reinforcing and balancing feedbacks.

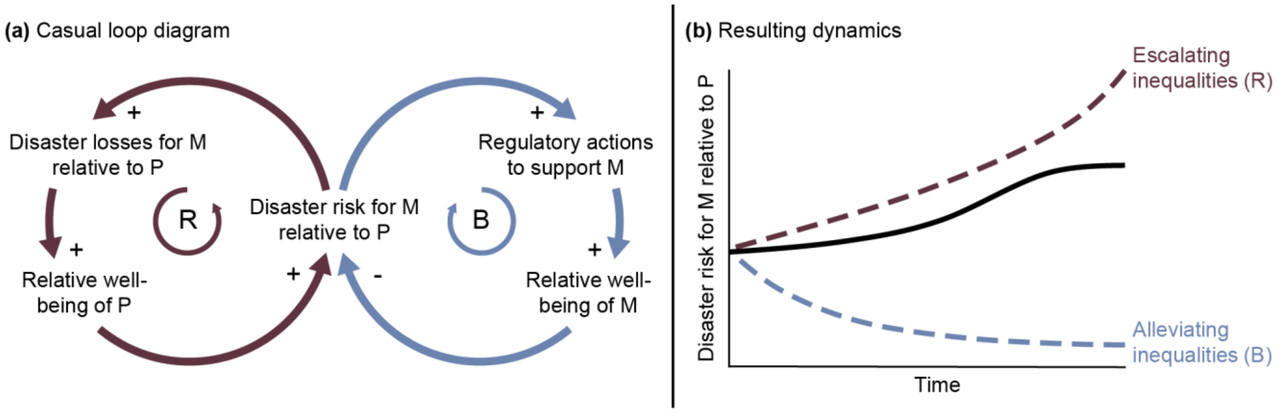

Figure 2. Vicious cycles and their disruptions. (a) Reinforcing (R) and balancing (B) feedback loops considering privileged (P) and marginalized (M) groups, whereby arrows indicate positive (+) or negative (−) causal relationships between variables. **(b)** Resulting dynamics from the two loops, i.e. escalating inequalities (R) and alleviating inequalities (B). Their relative strengths determine the composite trajectory (black line).

The example of Figure 3a focuses on well-being inequality between privileged (P) and marginalized (M) groups. Initially, group M faces higher disaster risk than group P due to its limited capacity to prevent, cope with and recover from disasters (Thaler, 2021). This disparity is exacerbated over time by the reinforcing (**R**) feedback loop characterised by increasing disaster impacts and decreasing well-being of M relative to P (red arrows in Figure 3a). Hence, the reinforcing feedback loop represents a vicious cycle of deepening inequalities.

The balancing (**B**) feedback loop hypothesises that the disparity in disaster risk for M relative to P prompts regulatory actions to support M by e.g. providing resources for specific risk reduction measures. These actions reduce disparities in disaster risk (blue arrows in Figure 3a). The strength of the two feedback loops (**R** vs. **B**), plausibly shaped by political will and power relationships, determines whether the vicious cycle of enhanced inequalities will be disrupted or not (Figure 3b).

Despite scientific progress in understanding the interplay between disasters and inequalities, most studies focused on single disasters in specific locations and/or only one side of the two-way feedbacks between inequalities and disasters. Moreover, research on human-water systems and sociohydrology has primarily focused on temporal dynamics, while the spatial heterogeneities of human-water feedbacks have not been sufficiently explored.

Hence, key knowledge gaps remain, including: 1) limited understanding of the interplay between long series of hydrological extremes and patterns of inequalities, and how these coupled dynamics are influenced by climate change and socioeconomic trends; 2) the primary mechanisms underlying (the breaking of) vicious cycles, across scales and along hydroclimatic and socioeconomic gradients, have yet to be comprehensively explored; 3) it is still unknown which elements of the vicious cycles, and their disruptions, are context-specific or reflect generic patterns that emerge under identifiable circumstances.

These knowledge gaps hinder our ability to: i) explain how the spatial distribution of hydrological risk changes over time; ii) project future trends across sectors and socioeconomic groups; and iii) assess the long-term effects of alternative policies for disaster risk reduction, sustainable development, and climate change adaptation.

Thus, there is a need to go beyond current approaches in sociohydrology that treat society as a homogeneous entity (Savelli et al., 2022) and develop new analytical tools capturing that: i) floods and droughts disproportionately affect some socioeconomic groups (Lindersson et al., 2023); ii) the use and development of water infrastructure (e.g. levees, dams, and reservoirs) are intertwined with political power and economic interests that make their costs and benefits unevenly distributed (Rusca et al., 2023); iii) different segments of society contribute more than others in exacerbating water-related disasters, e.g. unsustainable water consumption by privileged groups can turn droughts into major water crises (De Brito, 2023).

New models capturing inequalities

A new generation of system dynamics and agent-based models can build upon recent advances in modelling complex adaptive systems (Liu et al., 2007; Schlüter et al., 2019; Verburg et al., 2016) and sociohydrology (Di Baldassarre et al., 2017; Gohari et al., 2017; Haer et al., 2020; Mazzoleni et al., 2021; Pande and Sivapalan, 2017; Srinivasan et al., 2013) and address the above knowledge gaps to inform policy and action for the disruption of the vicious cycles of inequalities and disasters.

New models should formulate alternative hypotheses explaining the dynamics of vicious cycles of inequalities and disasters and their disruption, grounded in empirical studies and established theories for studying human-natural systems (Di Baldassarre et al., 2019; Schlüter et al., 2017). In particular, agent-based models (Abebe et al., 2019; Aerts et al., 2018; Haer et al., 2020) can be combined with system dynamics methods (Sterman, 2002) to capture feedback loops between multiple variables more complex than the simplified example of Figure 3. These models should account for additional mechanisms, multiple social groups, potential delays, threshold behaviour and other internal/external drivers of change. They must also address fast and slow dynamics across spatial and temporal scales (Blöschl et al., 2019; Yu et al., 2020), e.g. short-term measures for flood control vs. slow, cumulative drought impacts on vulnerable populations. These models can inform the making of adaptive policies that address immediate needs while also planning for long-term recovery and resilience.

Historical (temporal) legacy

Sociohydrological models should also be complemented by case studies of unequal distribution of impacts and recovery trajectories across sectors and social groups to investigate how the historical interplay of disasters and inequalities is shaped by: i) power relations and asymmetries (Savelli et al., 2021); ii) the intersection of socioeconomic status, gender, race, and ethnicity (Sultana, 2018; Zwarteveen et al., 2017); and iii) human behaviour, including cognitive heuristics in the decision-making process (Aerts et al., 2018).

This requires pluralising knowledge with greater engagement between research fields. Sociohydrology can build on recent work in disaster studies, political ecology, and environmental justice that has been critical in exploring how inequalities are rooted in broader patterns of uneven development. Scholars have shown how disasters can be exacerbated by structural processes embedded in historical and ongoing systems of oppression, including racial capitalism, class struggle, and colonialism, which continue to shape patterns of vulnerability and resilience (Andrijevic et al., 2020; Bolin and Kurtz, 2018; Collins, 2009; Rusca, 2024; Sultana, 2022).

Recognizing political and economic processes is essential for understanding the drivers and root causes of the vicious cycles and their disruptions. Critical social sciences can be a complementary lens to uncover politics and legacies.

Moreover, new case studies should go beyond the analysis of single events and explore long histories of consecutive disasters (Ruiter et al., 2020) to uncover how socioeconomic status, gender, race, and ethnicity have collectively shaped vulnerability over time in different segments of society.

Houston and the surrounding Harris County, for example, have been affected by several flooding events, and have suffered the highest number of flood fatalities in the USA over the past decades (Brody et al., 2011). An examination of consecutive flood events from 1996 to 2008 revealed a strong link between socio-economic disparities, the presence of minority populations, exposure to high-risk areas, and lower property values (Highfield et al., 2014). In the aftermath of these extreme events, racial minorities (African Americans and Hispanics) faced disproportionately greater housing losses and longer recovery periods (Peacock et al., 2014). Additionally, the reconstruction after the flood events of 2005 and 2008 was emblematic of the risk of neoliberal responses in an unequal societies (Rusca et al., 2021): private utilities avoided long-term infrastructure investments, shifted recovery costs to customers, and neglected both risk reduction and the social impact on the most vulnerable (Miller et al., 2011). Lastly, the reduction in public housing facilities further heightened the vulnerability of minority communities (Hamideh and Rongerude, 2018). The legacy of these uneven responses to flood events eventually exacerbated the catastrophic impacts of the 2017 flooding, which were unprecedented (Rusca et al., 2021). Black, Hispanic, and other minorities, as well as lower income households and people with a disability were disproportionally affected (Collins et al., 2019). Low-income neighbourhoods also faced a slow recovery process due to less access to flood insurance (Fernandez and Panich-Linsman, 2018).

Social and hydrological (spatial) heterogeneity

Global analyses of the unequal distribution of hydrological impacts and trajectories of societal recovery across sectors and social groups, of greater complexity than those depicted in Figure 2, are needed to investigate which elements of the vicious cycles and their disruptions are context-specific or reflect generic patterns that emerge under identifiable circumstances. To this end, the growing availability of satellite imagery and AI tools offers unprecedented opportunities for understanding the dynamics of disaster risk.

Recent developments in natural language processing (NLP), for example, enable the efficient extraction of impact information from large text, such as newspaper articles (Brito et al., 2020; Sodoge et al., 2024), government reports and Wikipedia entries (Li et al., 2024). This allows for complementing existing datasets and mapping the uneven distribution of the impacts of floods and droughts worldwide. NLP techniques can be employed to automatically detect and classify the geographic locations of extreme events, identify affected populations, and uncover how these impacts vary by social segments, such as elites, farmers, or urban poor. Furthermore, they can help us to understand which societal actors are considered and whose voices remain unheard (Nunes Carvalho et al., 2024). After adjusting for potential biases in the text data (Rodrigo-Ginés et al., 2024), these tools can help produce comprehensive, high-resolution datasets on disaster losses and recovery trajectories. This would allow for more nuanced analyses of how different groups experience and recover from disasters.

However, AI and NLP tools also raise critical concerns. The production of data, like all forms of knowledge, is shaped by power relations and involves choices that determine what becomes visible, knowable, and therefore acted upon in policy responses (Dencik et al., 2019). Therefore, we advocate for a reflexive approach to these tools that is attentive to potential biases and partialities of the data, grounded in a broader understanding of the structural drivers of disaster impacts and inequalities.

Breaking vicious cycles

The disruption of vicious cycles, or poverty traps, typically requires both short- and long-term strategies. The above examples of Cape Town and New Orleans showed that power relations matter for breaking the vicious cycle of hydrological disasters and socioeconomic inequalities, which are shaped by legacies of disinvestment, racial segregation, and uneven urban development.

Droughts and floods, while devastating, can also serve as windows of opportunity to address underlying vulnerabilities and catalyse change (Kreibich et al., 2017). In the short term, equitable interventions can provide relief and support to the most affected and marginalized populations, ensuring that disaster responses do not reinforce existing inequalities. Simultaneously, long-term, transformative approaches are needed to tackle structural and systemic factors that perpetuate vulnerability. By linking immediate, equitable action with strategic, forward-looking interventions, it becomes possible to break entrenched patterns of harm and foster resilient, just societies. We argue that expanding knowledge of how these mechanisms operate across different contexts, through the interdisciplinary research approach illustrated in this paper, will be essential to effectively dismantling the vicious cycles of disasters and inequalities.

Charting future opportunities

Unravelling the heterogeneity of the interplay between hydrological extremes and unequal societies has not only the potential to help break vicious cycles and poverty traps, but also to contribute to addressing major scientific challenges.

These include global initiatives of the International Hydrological Sciences Association (IAHS), i.e. unsolved problems in hydrology (Blöschl et al., 2019), HELPING (Arheimer et al., 2024), and Panta Rhei (Kreibich et al., 2025), as well as achieving a unified understanding of human–nature interactions (Soga and Gaston, 2022), all of which are needed for establishing a safe and just operating space for humanity (Oliver et al., 2022; Rockström et al., 2009).

New sociohydrological models can also inform more complex agent-based models (Haer et al., 2020; Pérez-Blanco et al., 2022), be linked to global models of disaster risk (Fox et al., 2024; Winsemius et al., 2016), and help advance and the modelling of climate change adaptation (Beckage et al., 2018; Palmer and Smith, 2014) that currently overlook the heterogeneity of societal feedbacks (Donges et al., 2020).

Combining theoretical and empirical work that integrate qualitative and quantitative information will enable better explanations of the temporal changes in the spatial distribution of hydrological risk, which is needed to better inform policies of sustainable water management, climate change adaptation and disaster risk reduction. It will also open up new horizons and opportunities for science by moving forward interdisciplinary efforts across physical, engineering and social sciences to study coupled human-natural systems (Shin et al., 2022).

Progress in modelling heterogeneous human-water systems will also enable exploring the potential effects of socioecological transformations (Willems-Braun, 2018), i.e. economic, cultural, and political projects that have not yet materialised. Moreover, it will allow for the assessment of how unprecedented or record-shattering events, i.e. floods or droughts of a magnitude that was not previously experienced (Kreibich et al., 2022; Rusca et al., 2023), may affect different segments of society in unequal ways. Such work is timely and crucial for generating knowledge that helps break vicious cycles in which disasters deepen existing inequalities and disproportionately affect vulnerable groups.

Acknowledgments

The research ideas presented here have emerged from numerous interactions with many hydrologists and water scientists involved in the IAHS research decade Panta Rhei as well as the new IAHS Human-Water Feedbacks Commission. Constructive comments by the Editor and two Anonymous Reviewers are also acknowledged. G.D.B. was funded by the European Research Council (ERC) for his project HydroSocialExtremes (771678) as well as by the European Commission in the context of the I-CISK (101037293) and TRANSCEND (10108411) EU Horizon Europe projects.

References

Abebe, Y.A., Ghorbani, A., Nikolic, I., Vojinovic, Z., Sanchez, A., 2019. Flood risk management in Sint Maarten – A coupled agent-based and flood modelling method. J. Environ. Manage. 248, 109317. https://doi.org/10.1016/j.jenvman.2019.109317

Adger, W.N., 2006. Vulnerability. Glob. Environ. Change, Resilience, Vulnerability, and Adaptation: A Cross-Cutting Theme of the International Human Dimensions Programme on Global Environmental Change 16, 268–281. https://doi.org/10.1016/j.gloenvcha.2006.02.006

Aerts, J.C.J.H., Botzen, W.J., Clarke, K.C., Cutter, S.L., Hall, J.W., Merz, B., Michel-Kerjan, E., Mysiak, J., Surminski, S., Kunreuther, H., 2018. Integrating human behaviour dynamics into flood disaster risk assessment. Nat. Clim. Change 8, 193–199. https://doi.org/10.1038/s41558-018-0085-1

Anbarci, N., Escaleras, M., Register, C.A., 2005. Earthquake fatalities: the interaction of nature and political economy. J. Public Econ. 89, 1907–1933. https://doi.org/10.1016/j.jpubeco.2004.08.002

Andrijevic, M., Crespo Cuaresma, J., Lissner, T., Thomas, A., Schleussner, C.-F., 2020. Overcoming gender inequality for climate resilient development. Nat. Commun. 11, 6261. https://doi.org/10.1038/s41467-020-19856-w

Arheimer, B., Cudennec, C., Castellarin, A., Grimaldi, S., Heal, K.V., Lupton, C., Sarkar, A., Tian, F., Kileshye Onema, J.-M., Archfield, S., Blöschl, G., Chaffe, P.L.B., Croke, B.F.W., Dembélé, M., Leong, C., Mijic, A., Mosquera, G.M., Nlend, B., Olusola, A.O., Polo, M.J., Sandells, M., Sheffield, J., van Hateren, T.C., Shafiei, M., Adla, S., Agarwal, A., Aguilar, C., Andersson, J.C.M., Andraos, C., Andreu, A., Avanzi, F., Bart, R.R., Bartosova, A., Batelaan, O., Bennett, J.C., Bertola, M., Bezak, N., Boekee, J., Bogaard, T., Booij, M.J., Brigode, P., Buytaert, W., Bziava, K., Castelli, G., Castro, C.V., Ceperley, N.C., Chidepudi, S.K.R., Chiew, F.H.S., Chun, K.P., Dagnew, A.G., Dekongmen, B.W., Del Jesus, M., Dezetter, A., Do Nascimento Batista, J.A., Doble, R.C., Dogulu, N., Eekhout, J.P.C., Elçi, A., Elenius, M., Finger, D.C., Fiori, A., Fischer, S., Förster, K., Ganora, D., Gargouri Ellouze, E., Ghoreishi, M., Harvey, N., Hrachowitz, M., Jampani, M., Jaramillo, F., Jongen, H.J., Kareem, K.Y., Khan, U.T., Khatami, S., Kingston, D.G., Koren, G., Krause, S., Kreibich, H., Lerat, J., Liu, J., Liu, S., Madruga de Brito, M., Mahé, G., Makurira, H., Mazzoglio, P., Merheb, M., Mishra, A., Mohammad, H., Montanari, A., Mujere, N., Nabavi, E., Nkwasa, A., Orduna Alegria, M.E., Orieschnig, C., Ovcharuk, V., Palmate, S.S., Pande, S., Pandey, S., Papacharalampous, G., Pechlivanidis, I., Penny, G., Pimentel, R., Post, D.A., Prieto, C., Razavi, S., Salazar-Galán, S., Sankaran Namboothiri, A., Santos, P.P., Savenije, H., Shanono, N.J., Sharma, A., Sivapalan, M., Smagulov, Z., Szolgay, J., Teng, J., Teuling, A.J., Teutschbein, C., Tyralis, H., Griensven, A. van, van Schalkwyk, A.J., van Tiel, M., Viglione, A., Volpi, E., Wagener, T., Wang, X., Wang-Erlandsson, L., Wens, M., Xia, J.,

2024. The IAHS Science for Solutions decade, with Hydrology Engaging Local People IN one Global world (HELPING). Hydrol. Sci. J. 69, 1417–1435. https://doi.org/10.1080/02626667.2024.2355202

Bates, P., 2023. Uneven burden of urban flooding. Nat. Sustain. 6, 9–10. https://doi.org/10.1038/s41893-022-01000-9

Beckage, B., Gross, L.J., Lacasse, K., Carr, E., Metcalf, S.S., Winter, J.M., Howe, P.D., Fefferman, N., Franck, T., Zia, A., Kinzig, A., Hoffman, F.M., 2018. Linking models of human behaviour and climate alters projected climate change. Nat. Clim. Change 8, 79–84. https://doi.org/10.1038/s41558-017-0031-7

Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N., Garschagen, M., Fernando, N., Kropp, J., 2010. Extreme events and disasters: a window of opportunity for change? Analysis of organizational, institutional and political changes, formal and informal responses after mega-disasters. Nat. Hazards 55, 637–655. https://doi.org/10.1007/s11069-008-9319-2

Blöschl, G., Bierkens, M.F.P., Chambel, A., Cudennec, C., Destouni, G., Fiori, A., Kirchner, J.W., McDonnell, J.J., Savenije, H.H.G., Sivapalan, M., Stumpp, C., Toth, E., Volpi, E., Carr, G., Lupton, C., Salinas, J., Széles, B., Viglione, A., Aksoy, H., Allen, S.T., Amin, A., Andréassian, V., Arheimer, B., Aryal, S.K., Baker, V., Bardsley, E., Barendrecht, M.H., Bartosova, A., Batelaan, O., Berghuijs, W.R., Beven, K., Blume, T., Bogaard, T., Amorim, P.B. de, Böttcher, M.E., Boulet, G., Breinl, K., Brilly, M., Brocca, L., Buytaert, W., Castellarin, A., Castelletti, A., Chen, X., Chen, Yangbo, Chen, Yuanfang, Chifflard, P., Claps, P., Clark, M.P., Collins, A.L., Croke, B., Dathe, A., David, P.C., Barros, F.P.J. de, Rooij, G. de, Baldassarre, G.D., Driscoll, J.M., Duethmann, D., Dwivedi, R., Eris, E., Farmer, W.H., Feiccabrino, J., Ferguson, G., Ferrari, E., Ferraris, S., Fersch, B., Finger, D., Foglia, L., Fowler, K., Gartsman, B., Gascoin, S., Gaume, E., Gelfan, A., Geris, J., Gharari, S., Gleeson, T., Glendell, M., Bevacqua, A.G., González-Dugo, M.P., Grimaldi, S., Gupta, A.B., Guse, B., Han, D., Hannah, D., Harpold, A., Haun, S., Heal, K., Helfricht, K., Herrnegger, M., Hipsey, M., Hlaváčiková, H., Hohmann, C., Holko, L., Hopkinson, C., Hrachowitz, M., Illangasekare, T.H., Inam, A., Innocente, C., Istanbulluoglu, E., Jarihani, B., Kalantari, Z., Kalvans, A., Khanal, S., Khatami, S., Kiesel, J., Kirkby, M., Knoben, W., Kochanek, K., Kohnová, S., Kolechkina, A., Krause, S., Kreamer, D., Kreibich, H., Kunstmann, H., Lange, H., Liberato, M.L.R., Lindquist, E., Link, T., Liu, J., Loucks, D.P., Luce, C., Mahé, G., Makarieva, O., Malard, J., Mashtayeva, S., Maskey, S., Mas-Pla, J., Mavrova-Guirguinova, M., Mazzoleni, M., Mernild, S., Misstear, B.D., Montanari, A., Müller-Thomy, H., Nabizadeh, A., Nardi, F., Neale, C., Nesterova, N., Nurtaev, B., Odongo, V.O., Panda, S., Pande, S., Pang, Z., Papacharalampous, G., Perrin, C., Pfister, L., Pimentel, R., Polo, M.J., Post, D., Sierra, C.P., Ramos, M.-H., Renner, M., Reynolds, J.E., Ridolfi, E., Rigon, R., Riva, M., Robertson, D.E., Rosso, R., Roy, T., Sá, J.H.M., Salvadori, G., Sandells, M., Schaefli, B., Schumann, A., Scolobig, A., Seibert, J., Servat, E., Shafiei, M., Sharma, A., Sidibe, M., Sidle, R.C., Skaugen, T., Smith, H., Spiessl, S.M., Stein, L., Steinsland, I., Strasser, U., Su, B., Szolgay, J., Tarboton, D., Tauro, F., Thirel, G., Tian, F., Tong, R., Tussupova, K., Tyralis, H., Uijlenhoet, R., Beek, R. van, Ent, R.J. van der, Ploeg, M. van der, Loon, A.F.V., Meerveld, I. van, Nooijen, R. van, Oel, P.R. van, Vidal, J.-P., Freyberg, J. von, Vorogushyn, S., Wachniew, P., Wade, A.J., Ward, P., Westerberg, I.K., White, C., Wood, E.F., Woods, R., Xu, Z., Yilmaz, K.K., Zhang, Y., 2019. Twenty-three unsolved problems in hydrology (UPH) – a community perspective. Hydrol. Sci. J. 64, 1141–1158. https://doi.org/10.1080/02626667.2019.1620507

Bolin, B., Kurtz, L.C., 2018. Race, class, ethnicity, and disaster vulnerability. Handb. Disaster Res. 181–203.

Botai, C.M., Botai, J.O., De Wit, J.P., Ncongwane, K.P., Adeola, A.M., 2017. Drought Characteristics over the Western Cape Province, South Africa. Water 9, 876. https://doi.org/10.3390/w9110876

Braun, B., 2015. Futures: Imagining Socioecological Transformation—An Introduction. Ann. Assoc. Am. Geogr. 105, 239–243. https://doi.org/10.1080/00045608.2014.1000893

Brito, M.M. de, Kuhlicke, C., Marx, A., 2020. Near-real-time drought impact assessment: a text mining approach on the 2018/19 drought in Germany. Environ. Res. Lett. 15, 1040a9. https://doi.org/10.1088/1748-9326/aba4ca
Brody, S.D., Highfield, W.E., Kang, J.E., 2011. Rising Waters: The Causes and Consequences of Flooding in the United States. Cambridge University Press, Cambridge. https://doi.org/10.1017/CBO9780511921568
Cappelli, F., Costantini, V., Consoli, D., 2021. The trap of climate change-induced “natural” disasters and inequality. Glob. Environ. Change 70, 102329. https://doi.org/10.1016/j.gloenvcha.2021.102329
Carter, M.R., Little, P.D., Mogues, T., Negatu, W., 2007. Poverty Traps and Natural Disasters in Ethiopia and Honduras. World Dev. 35, 835–856. https://doi.org/10.1016/j.worlddev.2006.09.010
Choong, J.J., Wagenaar, D., Rabonza, M.L., Hamel, P., Switzer, A.D., Lallemant, D., 2025. Shared hazards, unequal outcomes: income-driven inequities in disaster risk. Npj Nat. Hazards 2, 1–14. https://doi.org/10.1038/s44304-025-00087-2
Chrisendo, D., Niva, V., Hoffmann, R., Sayyar, S.M., Rocha, J., Sandström, V., Solt, F., Kummu, M., 2024. Income inequality has increased for over two-thirds of the global population. https://doi.org/10.21203/rs.3.rs-5548291/v1
Collins, T.W., 2009. The production of unequal risk in hazardscapes: An explanatory frame applied to disaster at the US–Mexico border. Geoforum, Themed Issue: The ‘view from nowhere’? Spatial politics and cultural significance of high-resolution satellite imagery 40, 589–601. https://doi.org/10.1016/j.geoforum.2009.04.009
Collins, T.W., Grineski, S.E., Chakraborty, J., Flores, A.B., 2019. Environmental injustice and Hurricane Harvey: A household-level study of socially disparate flood exposures in Greater Houston, Texas, USA. Environ. Res. 179, 108772. https://doi.org/10.1016/j.envres.2019.108772
Cooke, K., 2019. Questions of resilience in municipal finance response to a shock event: a case study of the Cape Town drought.
Cutter, S.L., Boruff, B.J., Shirley, W.L., 2003. Social Vulnerability to Environmental Hazards*. Soc. Sci. Q. 84, 242–261. https://doi.org/10.1111/1540-6237.8402002
De Brito, Madruga, M., 2023. Cities dried up by few. Nat. Sustain. 6, 883–884. https://doi.org/10.1038/s41893-023-01097-6
De Silva, M.M.G.T., Kawasaki, A., 2020. A local-scale analysis to understand differences in socioeconomic factors affecting economic loss due to floods among different communities. Int. J. Disaster Risk Reduct. 47, 101526. https://doi.org/10.1016/j.ijdrr.2020.101526
Dencik, L., Hintz ,Arne, Redden ,Joanna, and Treré, E., 2019. Exploring Data Justice: Conceptions, Applications and Directions. Inf. Commun. Soc. 22, 873–881. https://doi.org/10.1080/1369118X.2019.1606268
Di Baldassarre, G., Martinez, F., Kalantari, Z., Viglione, A., 2017. Drought and flood in the Anthropocene: feedback mechanisms in reservoir operation. Earth Syst. Dyn. 8, 225–233. https://doi.org/10.5194/esd-8-225-2017
Di Baldassarre, G., Sivapalan, M., Rusca, M., Cudennec, C., Garcia, M., Kreibich, H., Konar, M., Mondino, E., Mård, J., Pande, S., Sanderson, M.R., Tian, F., Viglione, A., Wei, J., Wei, Y., Yu, D.J., Srinivasan, V., Blöschl, G., 2019. Sociohydrology: Scientific Challenges in Addressing the Sustainable Development Goals. Water Resour. Res. 55, 6327–6355. https://doi.org/10.1029/2018WR023901
Donges, J.F., Heitzig, J., Barfuss, W., Wiedermann, M., Kassel, J.A., Kittel, T., Kolb, J.J., Kolster, T., Müller-Hansen, F., Otto, I.M., Zimmerer, K.B., Lucht, W., 2020. Earth system modeling with endogenous and dynamic human societies: the copan:CORE open World–Earth modeling framework. Earth Syst. Dyn. 11, 395–413. https://doi.org/10.5194/esd-11-395-2020
Elliott, J.R., Pais, J., 2006. Race, class, and Hurricane Katrina: Social differences in human responses to disaster. Soc. Sci. Res., Katrina in New Orleans/Special Issue on Contemporary Research on the Family 35, 295–321. https://doi.org/10.1016/j.ssresearch.2006.02.003

Enarson, E., 1998. Through Women's Eyes: A Gendered Research Agenda for Disaster Social Science. Disasters 22, 157–173. https://doi.org/10.1111/1467-7717.00083

Fernandez, M., Panich-Linsman, I., 2018. A Year After Hurricane Harvey, Houston's Poorest Neighborhoods Are Slowest to Recover. N. Y. Times.

Ferraro, P.J., Sanchirico, J.N., Smith, M.D., 2019. Causal inference in coupled human and natural systems. Proc. Natl. Acad. Sci. 116, 5311–5318. https://doi.org/10.1073/pnas.1805563115

Finch, C., Emrich, C.T., Cutter, S.L., 2010a. Disaster disparities and differential recovery in New Orleans. Popul. Environ. 31, 179–202.

Finch, C., Emrich, C.T., Cutter, S.L., 2010b. Disaster disparities and differential recovery in New Orleans. Popul. Environ. 31, 179–202.

Floods claim more lives where inequality reigns, 2023. . Nature 616, 633–633. https://doi.org/10.1038/d41586-023-01280-x

Folke, C., Hahn, T., Olsson, P., Norberg, J., 2005. Adaptive governance of social-ecological systems. Annu Rev Env. Resour 30, 441–473.

Fox, S., Agyemang, F., Hawker, L., Neal, J., 2024. Integrating social vulnerability into high-resolution global flood risk mapping. Nat. Commun. 15, 3155. https://doi.org/10.1038/s41467-024-47394-2

Fussell, E., 2015. The Long-Term Recovery of New Orleans' Population After Hurricane Katrina. Am. Behav. Sci. 59, 1231–1245. https://doi.org/10.1177/0002764215591181

Fussell, E., Sastry, N., VanLandingham, M., 2010. Race, socioeconomic status, and return migration to New Orleans after Hurricane Katrina. Popul. Environ. 31, 20–42. https://doi.org/10.1007/s11111-009-0092-2

Gohari, A., Mirchi, A., Madani, K., 2017. System Dynamics Evaluation of Climate Change Adaptation Strategies for Water Resources Management in Central Iran. Water Resour. Manag. 31, 1413–1434. https://doi.org/10.1007/s11269-017-1575-z

Haer, T., Husby, T.G., Botzen, W.J.W., Aerts, J.C.J.H., 2020. The safe development paradox: An agent-based model for flood risk under climate change in the European Union. Glob. Environ. Change 60, 102009. https://doi.org/10.1016/j.gloenvcha.2019.102009

Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Bangalore, M., Beaudet, C., 2020. From Poverty to Disaster and Back: a Review of the Literature. Econ. Disasters Clim. Change 4, 223–247. https://doi.org/10.1007/s41885-020-00060-5

Hamideh, S., Rongerude, J., 2018. Social vulnerability and participation in disaster recovery decisions: public housing in Galveston after Hurricane Ike. Nat. Hazards 93, 1629–1648. https://doi.org/10.1007/s11069-018-3371-3

Highfield, W.E., Peacock, W.G., Van Zandt, S., 2014. Mitigation Planning: Why Hazard Exposure, Structural Vulnerability, and Social Vulnerability Matter. J. Plan. Educ. Res. 34, 287–300. https://doi.org/10.1177/0739456X14531828

Intergovernmental Panel on Climate Change (IPCC), 2023. Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge. https://doi.org/10.1017/9781009325844

Jonkman, S.N., Maaskant, B., Boyd, E., Levitan, M.L., 2009. Loss of Life Caused by the Flooding of New Orleans After Hurricane Katrina: Analysis of the Relationship Between Flood Characteristics and Mortality. Risk Anal. 29, 676–698. https://doi.org/10.1111/j.1539-6924.2008.01190.x

Kallis, G., 2010. Coevolution in water resource development: The vicious cycle of water supply and demand in Athens, Greece. Ecol. Econ., Special Section: Coevolutionary Ecological Economics: Theory and Applications 69, 796–809. https://doi.org/10.1016/j.ecolecon.2008.07.025

Kammerbauer, M., Wamsler, C., 2017. Social inequality and marginalization in post-disaster recovery: Challenging the consensus? Int. J. Disaster Risk Reduct. 24, 411–418. https://doi.org/10.1016/j.ijdrr.2017.06.019

Kates, R.W., Colten, C.E., Laska, S., Leatherman, S.P., 2006. Reconstruction of New Orleans after Hurricane Katrina: A research perspective. Proc. Natl. Acad. Sci. 103, 14653–14660. https://doi.org/10.1073/pnas.0605726103

Kreibich, H., Di Baldassarre, G., Vorogushyn, S., Aerts, J.C.J.H., Apel, H., Aronica, G.T., Arnbjerg-Nielsen, K., Bouwer, L.M., Bubeck, P., Caloiero, T., Chinh, D.T., Cortès, M., Gain, A.K., Giampá, V., Kuhlicke, C., Kundzewicz, Z.W., Llasat, M.C., Mård, J., Matczak, P., Mazzoleni, M., Molinari, D., Dung, N.V., Petrucci, O., Schröter, K., Slager, K., Thieken, A.H., Ward, P.J., Merz, B., 2017. Adaptation to flood risk: Results of international paired flood event studies. Earths Future 953–965. https://doi.org/10.1002/2017EF000606@10.1002/(ISSN)2328-4277.HAZARDS1

Kreibich, H., Sivapalan, M., AghaKouchak, A., Addor, N., Aksoy, H., Arheimer, B., Arnbjerg-Nielsen, K., Vail-Castro, C., Cudennec, C., Madruga de Brito, M., Di Baldassarre, G., Finger, D.C., Fowler, K., Knoben, W., Krueger, T., Liu, J., Macdonald, E., McMillan, H., Mendiondo, E.M., Montanari, A., Muller, M.F., Pande, S., Tian, F., Viglione, A., Wei, Y., Castellarin, A., Loucks, D.P., Oki, T., Polo, M.J., Savenije, H., Van Loon, A.F., Agarwal, A., Alvarez-Garreton, C., Andreu, A., Barendrecht, M.H., Brunner, M., Cavalcante, L., Cavus, Y., Ceola, S., Chaffe, P., Chen, X., Coxon, G., Dandan, Z., Davary, K., Dembélé, M., Dewals, B., Frolova (Bibikova), T., Gain, A.K., Gelfan, A., Ghoreishi, M., Grabs, T., Guan, X., Hannah, D.M., Helmschrot, J., Höllermann, B., Hounkpè, J., Koebele, E., Konar, M., Kratzert, F., Lindersson, S., Llasat, M.C., Matanó, A., Mazzoleni, M., Mejia, A., Mendoza, P., Merz, B., Mukherjee, J., Nasiri Saleh, F., Nlend, B., Nonki, R.M., Orieschnig, C., Papagiannaki, K., Penny, G., Petrucci, O., Pimentel, R., Pool, S., Ridolfi, E., Rusca, M., Sairam, N., Sankaran Namboothiri, A., Sarmento Buarque, A.C., Savelli, E., Schoppa, L., Schröter, K., Scolobig, A., Shafiei, M., Sikorska-Senoner, A.E., Smigaj, M., Teutschbein, C., Thaler, T., Todorovic, A., Tootoonchi, F., Tootoonchi, R., Toth, E., van Nooijen, R., Vanelli, F.M., Vásquez, N., Walker, D.W., Wens, M., Yu, D.J., Zarei, H., Zhou, C., Blöschl, G., 2025. Panta Rhei: a decade of progress in research on change in hydrology and society. Hydrol. Sci. J. 70, 1210–1236. https://doi.org/10.1080/02626667.2025.2469762

Kreibich, H., Van Loon, A.F., Schröter, K., Ward, P.J., Mazzoleni, M., Sairam, N., Abeshu, G.W., Agafonova, S., AghaKouchak, A., Aksoy, H., Alvarez-Garreton, C., Aznar, B., Balkhi, L., Barendrecht, M.H., Biancamaria, S., Bos-Burgering, L., Bradley, C., Budiyono, Y., Buytaert, W., Capewell, L., Carlson, H., Cavus, Y., Couasnon, A., Coxon, G., Daliakopoulos, I., de Ruiter, M.C., Delus, C., Erfurt, M., Esposito, G., François, D., Frappart, F., Freer, J., Frolova, N., Gain, A.K., Grillakis, M., Grima, J.O., Guzmán, D.A., Huning, L.S., Ionita, M., Kharlamov, M., Khoi, D.N., Kieboom, N., Kireeva, M., Koutroulis, A., Lavado-Casimiro, W., Li, H.-Y., LLasat, M.C., Macdonald, D., Mård, J., Mathew-Richards, H., McKenzie, A., Mejia, A., Mendiondo, E.M., Mens, M., Mobini, S., Mohor, G.S., Nagavciuc, V., Ngo-Duc, T., Thao Nguyen Huynh, T., Nhi, P.T.T., Petrucci, O., Nguyen, H.Q., Quintana-Seguí, P., Razavi, S., Ridolfi, E., Riegel, J., Sadik, M.S., Savelli, E., Sazonov, A., Sharma, S., Sörensen, J., Arguello Souza, F.A., Stahl, K., Steinhausen, M., Stoelzle, M., Szalińska, W., Tang, Q., Tian, F., Tokarczyk, T., Tovar, C., Tran, T.V.T., Van Huijgevoort, M.H.J., van Vliet, M.T.H., Vorogushyn, S., Wagener, T., Wang, Y., Wendt, D.E., Wickham, E., Yang, L., Zambrano-Bigiarini, M., Blöschl, G., Di Baldassarre, G., 2022. The challenge of unprecedented floods and droughts in risk management. Nature 608, 80–86. https://doi.org/10.1038/s41586-022-04917-5

Kruczkiewicz, A., Hultquist, C., Dutta, M., Iyer, R., 2023. Are Underserved Populations Left Out of National Flood Mitigation Efforts and Facing Greater Impact? A Method to Assess Racial Inequality at the Census Tract Level. J. Clim. Resil. Justice 1, 78–92. https://doi.org/10.1162/crcj_a_00005

Li, N., Zahra, S., Brito, M., Flynn, C., Görnerup, O., Worou, K., Kurfali, M., Meng, C., Thiery, W., Zscheischler, J., Messori, G., Nivre, J., 2024. Using LLMs to Build a Database of Climate Extreme Impacts, in: Stammbach, D., Ni, J., Schimanski, T., Dutia, K., Singh, A., Bingler, J., Christiaen, C., Kushwaha, N., Muccione, V., A. Vaghefi, S., Leippold, M. (Eds.), Proceedings of the 1st Workshop on Natural Language Processing Meets Climate Change

(ClimateNLP 2024). Association for Computational Linguistics, Bangkok, Thailand, pp. 93–110. https://doi.org/10.18653/v1/2024.climatenlp-1.7
Lindersson, S., Raffetti, E., Rusca, M., Brandimarte, L., Mård, J., Di Baldassarre, G., 2023. The wider the gap between rich and poor the higher the flood mortality. Nat. Sustain. 1–11. https://doi.org/10.1038/s41893-023-01107-7
Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., Pell, A.N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., Ouyang, Z., Provencher, W., Redman, C.L., Schneider, S.H., Taylor, W.W., 2007. Complexity of Coupled Human and Natural Systems. Science 317, 1513–1516. https://doi.org/10.1126/science.1144004
Masozera, M., Bailey, M., Kerchner, C., 2007. Distribution of impacts of natural disasters across income groups: A case study of New Orleans. Ecol. Econ., Ecological Economics of Coastal Disasters 63, 299–306. https://doi.org/10.1016/j.ecolecon.2006.06.013
Mazzoleni, M., Mondino, E., Di Baldassarre, G., Odongo, V.O., 2021. Water management, hydrological extremes, and society : modeling interactions and phenomena. Ecol. Soc. 26.
Miller, L.M., Antonio, R.J., Bonanno, A., 2011. Hazards of neoliberalism: delayed electric power restoration after Hurricane Ike. Br. J. Sociol. 62, 504–522. https://doi.org/10.1111/j.1468-4446.2011.01376.x
Mirchi, A., Madani, K., Watkins, D., Ahmad, S., 2012. Synthesis of System Dynamics Tools for Holistic Conceptualization of Water Resources Problems. Water Resour. Manag. 26, 2421–2442. https://doi.org/10.1007/s11269-012-0024-2
Neil Adger, W., Arnell, N.W., Tompkins, E.L., 2005. Successful adaptation to climate change across scales. Glob. Environ. Change, Adaptation to Climate Change: Perspectives Across Scales 15, 77–86. https://doi.org/10.1016/j.gloenvcha.2004.12.005
Nunes Carvalho, T.M., Souza Filho, F. de A. de, Madruga de Brito, M., 2024. Unveiling water allocation dynamics: a text analysis of 25 years of stakeholder meetings. Environ. Res. Lett. 19, 044066. https://doi.org/10.1088/1748-9326/ad37cd
Oliver, T.H., Doherty, B., Dornelles, A., Gilbert, N., Greenwell, M.P., Harrison, L.J., Jones, I.M., Lewis, A.C., Moller, S.J., Pilley, V.J., Tovey, P., Weinstein, N., 2022. A safe and just operating space for human identity: a systems perspective. Lancet Planet. Health 6, e919–e927. https://doi.org/10.1016/S2542-5196(22)00217-0
Olson, R.S., Gawronski, V.T., 2003. Disasters as Critical Junctures? Managua, Nicaragua 1972 and Mexico City 1985. Int. J. Mass Emergencies Disasters 21, 5–35. https://doi.org/10.1177/028072700302100101
Oronce, C.I.A., Scannell, C.A., Kawachi, I., Tsugawa, Y., 2020. Association Between State-Level Income Inequality and COVID-19 Cases and Mortality in the USA. J. Gen. Intern. Med. 35, 2791–2793. https://doi.org/10.1007/s11606-020-05971-3
Pahl-Wostl, C., Holtz, G., Kastens, B., Knieper, C., 2010. Analyzing complex water governance regimes: the Management and Transition Framework. Environ. Sci. Policy, Special issue: Water governance in times of change 13, 571–581. https://doi.org/10.1016/j.envsci.2010.08.006
Palmer, P.I., Smith, M.J., 2014. Earth systems: Model human adaptation to climate change. Nature 512, 365–366. https://doi.org/10.1038/512365a
Pande, S., Sivapalan, M., 2017. Progress in socio-hydrology: a meta-analysis of challenges and opportunities. WIREs Water 4, e1193. https://doi.org/10.1002/wat2.1193
Parthasarathy, D., 2018. Inequality, uncertainty, and vulnerability: Rethinking governance from a disaster justice perspective. Environ. Plan. E Nat. Space 1, 422–442.
Peacock, W.G., Van Zandt, S., Zhang, Y., Highfield, W.E., 2014. Inequities in Long-Term Housing Recovery After Disasters. J. Am. Plann. Assoc. 80, 356–371. https://doi.org/10.1080/01944363.2014.980440
Pérez-Blanco, C.D., Parrado, R., Essenfelder, A.H., Bodoque, J., Gil-García, L., Gutiérrez-Martín, C., Ladera, J., Standardi, G., 2022. Assessing farmers' adaptation responses to water conservation policies through modular recursive hydro-micro-macro-economic modeling. J. Clean. Prod. 360, 132208. https://doi.org/10.1016/j.jclepro.2022.132208

Picou, J.S., 2009. Katrina as a Natech Disaster: Toxic Contamination and Long-Term Risks for Residents of New Orleans. J. Appl. Soc. Sci. 3, 39–55. https://doi.org/10.1177/193672440900300204
Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H.J., Nykvist, B., de Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., Foley, J., 2009. Planetary Boundaries: Exploring the Safe Operating Space for Humanity. Ecol. Soc. 14.
Rodrigo-Ginés, F.-J., Carrillo-de-Albornoz, J., Plaza, L., 2024. A systematic review on media bias detection: What is media bias, how it is expressed, and how to detect it. Expert Syst. Appl. 237, 121641. https://doi.org/10.1016/j.eswa.2023.121641
Ruiter, M.C. de, Couasnon, A., Homberg, M.J.C. van den, Daniell, J.E., Gill, J.C., Ward, P.J., 2020. Why we can no longer ignore consecutive disasters. Earths Future 8, e2019EF001425. https://doi.org/10.1029/2019EF001425
Rusca, M., 2024. Towards a future-oriented political ecology of climate change. Geoforum 153, 103921. https://doi.org/10.1016/j.geoforum.2023.103921
Rusca, M., Messori, G., Baldassarre, G.D., 2021. Scenarios of human responses to unprecedented social-environmental extreme events. Earths Future n/a, e2020EF001911. https://doi.org/10.1029/2020EF001911
Rusca, M., Savelli, E., Di Baldassarre, G., Biza, A., Messori, G., 2023. Unprecedented droughts are expected to exacerbate urban inequalities in Southern Africa. Nat. Clim. Change 13, 98–105. https://doi.org/10.1038/s41558-022-01546-8
Sanders, B.F., Schubert, J.E., Kahl, D.T., Mach, K.J., Brady, D., AghaKouchak, A., Forman, F., Matthew, R.A., Ulibarri, N., Davis, S.J., 2023. Large and inequitable flood risks in Los Angeles, California. Nat. Sustain. 6, 47–57. https://doi.org/10.1038/s41893-022-00977-7
Savelli, E., Mazzoleni, M., Di Baldassarre, G., Cloke, H., Rusca, M., 2023. Urban water crises driven by elites' unsustainable consumption. Nat. Sustain. 1–12. https://doi.org/10.1038/s41893-023-01100-0
Savelli, E., Rusca, M., Cloke, H., Di Baldassarre, G., 2022. Drought and society: Scientific progress, blind spots, and future prospects. WIREs Clim. Change 13, e761. https://doi.org/10.1002/wcc.761
Savelli, E., Rusca, M., Cloke, H., Di Baldassarre, G., 2021. Don't blame the rain: Social power and the 2015–2017 drought in Cape Town. J. Hydrol. 594, 125953. https://doi.org/10.1016/j.jhydrol.2020.125953
Schlüter, M., Baeza, A., Dressler, G., Frank, K., Groeneveld, J., Jager, W., Janssen, M.A., McAllister, R.R.J., Müller, B., Orach, K., Schwarz, N., Wijermans, N., 2017. A framework for mapping and comparing behavioural theories in models of social-ecological systems. Ecol. Econ. 131, 21–35. https://doi.org/10.1016/j.ecolecon.2016.08.008
Schlüter, M., Müller, B., Frank, K., 2019. The potential of models and modeling for social-ecological systems research: the reference frame ModSES. Ecol. Soc. 24.
Shin, Y.A., Lacasse, K., Gross, L.J., Beckage, B., 2022. How coupled is coupled human-natural systems research? Ecol. Soc. 27. https://doi.org/10.5751/ES-13228-270304
Siddiqi, A., Collins, R.D., 2017. Sociotechnical systems and sustainability: current and future perspectives for inclusive development. Curr. Opin. Environ. Sustain., Sustainability science 24, 7–13. https://doi.org/10.1016/j.cosust.2017.01.006
Sivapalan, M., Savenije, H.H.G., Blöschl, G., 2012. Socio-hydrology: A new science of people and water. Hydrol. Process. 26, 1270–1276. https://doi.org/10.1002/hyp.8426
Sodoge, J., Kuhlicke, C., Mahecha, M.D., de Brito, M.M., 2024. Text mining uncovers the unique dynamics of socio-economic impacts of the 2018–2022 multi-year drought in Germany. Nat. Hazards Earth Syst. Sci. 24, 1757–1777. https://doi.org/10.5194/nhess-24-1757-2024
Soga, M., Gaston, K.J., 2022. Towards a unified understanding of human–nature interactions. Nat. Sustain. 5, 374–383. https://doi.org/10.1038/s41893-021-00818-z

Solt, F., 2025. The Standardized World Income Inequality Database, Versions 8-9. https://doi.org/10.7910/DVN/LM4OWF
Solt, F., 2020. Measuring Income Inequality Across Countries and Over Time: The Standardized World Income Inequality Database. Soc. Sci. Q. 101, 1183–1199. https://doi.org/10.1111/ssqu.12795
Srinivasan, V., Seto, K.C., Emerson, R., Gorelick, S.M., 2013. The impact of urbanization on water vulnerability: A coupled human–environment system approach for Chennai, India. Glob. Environ. Change 23, 229–239. https://doi.org/10.1016/j.gloenvcha.2012.10.002
Sterman, J., 2002. System Dynamics: Systems Thinking and Modeling for a Complex World (Working Paper). Massachusetts Institute of Technology. Engineering Systems Division.
Sultana, F., 2022. The unbearable heaviness of climate coloniality. Polit. Geogr. 99, 102638. https://doi.org/10.1016/j.polgeo.2022.102638
Sultana, F., 2018. Water justice: why it matters and how to achieve it. Water Int. 43, 483–493. https://doi.org/10.1080/02508060.2018.1458272
Thaler, T., 2021. Social justice in socio-hydrology—how we can integrate the two different perspectives. Hydrol. Sci. J. 66, 1503–1512. https://doi.org/10.1080/02626667.2021.1950916
Thaler, T., Hartmann, T., 2016a. Justice and flood risk management: reflecting on different approaches to distribute and allocate flood risk management in Europe. Nat. Hazards 83, 129–147. https://doi.org/10.1007/s11069-016-2305-1
Thaler, T., Hartmann, T., 2016b. Justice and flood risk management: reflecting on different approaches to distribute and allocate flood risk management in Europe. Nat. Hazards 83, 129–147.
Tovar Reaños, M.A., 2021a. Floods, flood policies and changes in welfare and inequality: Evidence from Germany. Ecol. Econ. 180, 106879. https://doi.org/10.1016/j.ecolecon.2020.106879
Tovar Reaños, M.A., 2021b. Floods, flood policies and changes in welfare and inequality: Evidence from Germany. Ecol. Econ. 180, 106879. https://doi.org/10.1016/j.ecolecon.2020.106879
Turner, B.L., Matson, P.A., McCarthy, J.J., Corell, R.W., Christensen, L., Eckley, N., Hovelsrud-Broda, G.K., Kasperson, J.X., Kasperson, R.E., Luers, A., Martello, M.L., Mathiesen, S., Naylor, R., Polsky, C., Pulsipher, A., Schiller, A., Selin, H., Tyler, N., 2003. Illustrating the coupled human–environment system for vulnerability analysis: Three case studies. Proc. Natl. Acad. Sci. 100, 8080–8085. https://doi.org/10.1073/pnas.1231334100
United Nations, 2020. World Social Report 2020: Inequality in a Rapidly Changing World. UN. https://doi.org/10.18356/7f5d0efc-en
van Bavel, B., Curtis, D., Soens, T., 2018. Economic inequality and institutional adaptation in response to flood hazards: a historical analysis. Ecol. Soc. 23. https://doi.org/10.5751/ES-10491-230430
Verburg, P.H., Dearing, J.A., Dyke, J.G., Leeuw, S. van der, Seitzinger, S., Steffen, W., Syvitski, J., 2016. Methods and approaches to modelling the Anthropocene. Glob. Environ. Change 39, 328–340. https://doi.org/10.1016/j.gloenvcha.2015.08.007
Vin, L., Kawasaki, A., 2024. Do floods widen the economic disparity gap? Prog. Disaster Sci. 24, 100362. https://doi.org/10.1016/j.pdisas.2024.100362
Willems-Braun, B. (Ed.), 2018. Futures: Imagining Socioecological Transformation. Routledge, London. https://doi.org/10.4324/9781315618548
Wing, O.E.J., Lehman, W., Bates, P.D., Sampson, C.C., Quinn, N., Smith, A.M., Neal, J.C., Porter, J.R., Kousky, C., 2022. Inequitable patterns of US flood risk in the Anthropocene. Nat. Clim. Change 12, 156–162. https://doi.org/10.1038/s41558-021-01265-6
Winsemius, H.C., Aerts, J.C.J.H., van Beek, L.P.H., Bierkens, M.F.P., Bouwman, A., Jongman, B., Kwadijk, J.C.J., Ligtvoet, W., Lucas, P.L., van Vuuren, D.P., Ward, P.J., 2016. Global drivers of future river flood risk. Nat. Clim. Change 6, 381–385. https://doi.org/10.1038/nclimate2893
Yu, D., Chang, H., Davis, T., Hillis, V., Marston, L., Oh, W.S., Sivapalan, M., Waring, T., 2020. Socio-hydrology: an interplay of design and self-organization in a multilevel world. Ecol. Soc. 25. https://doi.org/10.5751/ES-11887-250422

Zwarteveen, M., Kemerink-Seyoum, J.S., Kooy, M., Evers, J., Guerrero, T.A., Batubara, B., Biza, A., Boakye-Ansah, A., Faber, S., Cabrera Flamini, A., 2017. Engaging with the politics of water governance. Wiley Interdiscip. Rev. Water 4, e1245.